DOCUMENT RESUME

ED 347 981 IR 015 718

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TITLE An Advance toward Instructional Management: Prescriptive Knowledge Base of Learner Control.
PUB DATE Feb 92
NOTE 12p.; In: Proceedings of Selected Research and Development Presentations at the Convention of the Association for Educational Communications and Technology and Sponsored by the Research and Theory Division; see IR 015 706.
PUB TYPE Guides - General (050) -- Information Analyses (070) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Diagnostic Teaching; Elementary Secondary Education; Guidelines; Higher Education; *Instructional Design; *Instructional Effectiveness; Instructional Systems; *Learner Controlled Instruction; Outcomes of Education; Student Characteristics; Teaching Methods
IDENTIFIERS *Knowledge Bases

ABSTRACT

This paper discusses learner control as one of the main issues in instructional management and the importance of effectiveness and efficiency in the context of instructional/learning systems, and develops instructional prescriptions for learner control in a smorgasbord fashion. Strategies from both empirical and theoretical studies related to learner control were analyzed and classified by the Conditions-Methods-Outcomes (C-M-O) paradigm. It was found that current instructional prescriptions of learner control are composed of: (1) three instructional outcomes, i.e., effectiveness, efficiency, and appeal of the instruction; (2) three categories of instructional condition variables, i.e., learner characteristics, learning objectives or domains, and learning/instructional systems; and (3) five or more types of method variables, including content control, display (strategy) control, internal processing control such as conscious cognition and metacognition, intelligent advisor, advisement strategy, macro-level control (e.g., sequencing, selecting, summarizing, and synthesizing), user control, and system control. Prescriptions are then presented for content, sequence, pace, display or strategy, and internal processing control; conscious cognition; metacognition; and advisor strategies. It is suggested that teachers and instructional designers can use this prescriptive knowledge base to maximize the effectiveness and efficiency of learning by their students in specific situations. (32 references) (BBM)

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An Advance toward Instructional Management: Prescriptive Knowledge Base of Learner Control

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Research Background

Learner control is widely believed to be a highly desirable feature of interactive learning systems because learner control allows learning to be individualized to each learner's needs. Learner control of instruction is intuitively appealing since it is assumed that learners will be more motivated if allowed to control their own learning.

However, research findings regarding the effects of learner control have been inconclusive, but more frequently negative than positive (Carrier & Sales, 1987; Steinberg, 1977; Tennyson, 1980; Ross & Morrison, 1989). Whereas learner control of instructional options has a great deal of intuitive appeal, and an enormous amount of computer-based program design has been carried out, much of research contradicts unrestricted learner control (Hannafin & Peck, 1984).

These negative findings may occur because many students, especially low achievers, lack the knowledge and motivation to make appropriate decisions regarding such conditions as pacing, sequencing of content, use of learning aids, and amount of practice. These negative findings may also exist because most learner control strategies employed in research have been insufficient, piece-meal, or narrow.

Teachers and instructional designers may require more systematic guidelines for implementing effective learner control in real world situations. A comprehensive, integrated, diverse, prescriptive, and specific theory/model of learner control that is viable for the interactive learning systems may lead to more effective implementation of learner control.

Research Questions

- What types of learner control are available in learning situations?
- What are the condition variables and the outcome variables when learner control types are considered as the method variable?
- How can educators and instructional designers identify the functional relationship between learner control and learner's cognitive development, between learner control and learning domains, and between learner control and learner's motivation?
- What can be done to ensure that learners will be able to effectively control and regulate their own learning in different instructional systems including non-individualized systems, individualized systems, intelligent learning systems, and hypermedia systems?

Research Procedure

This study reviews a variety of literature (both empirical and theoretical) relevant to "learner control." Learner control strategies reviewed by the researcher are analyzed and classified by the Conditions-Methods-Outcomes [C-M-O] paradigm (Reigeluth, 1983).

In this research, a variety of learner control methods (including content control, sequence control, pace control, display control, internal processing control, conscious cognition, metacognition, intelligent advisor, advisement strategy, etc.) are identified and integrated. This study inductively integrated the current knowledge base concerning learner control into a prescriptive form that would be useful to instructional designers and teachers. This study prescribed the "smorgasbord"of individual learner control strategies to cope with individual learning and instructional situations, as does Keller's ARCS model of motivational design (Keller & Kopp, 1987).

Results

The current instructional prescriptions of learner control are composed of: (1) three instructional outcomes; (2) three categories of instructional condition variables; and (3) five or more types of method variables.

Insert Figure 1 (Variables of Learner Control) about here

Instructional Outcomes

Instruction is judged by its effectiveness, efficiency, and appeal in the context of instructional management (that is, learner control). Reigeluth (1979, 1983) classifies learner outcomes into three categories: effectiveness, efficiency, and appeal of the instruction. Four important aspects of the effectiveness of instruction are the accuracy ("error rate"), the speed ("performance efficiency"), the degree of transfer, and the length of retention. The efficiency of instruction is usually measured by the effectiveness divided by the student time and the cost of instruction. The appeal of instruction is measured by learner's appreciation and desire for more.

Instructional Conditions

The selection of specific learner control strategies is determined by three sets of condition variables: (1) learner characteristics; (2) learning objectives (or domains); and (3) learning/instructional systems. Learning domains are usually considered constraint and constraint can be a condition variable. Learning systems are frequently regarded as a method variable, but in this study, they are only part of learning environment (i.e., condition variable)

The learner characteristics involve the learner's cognitive developmental stage (readiness), motivation, task persistence, aptitude, ability, prior knowledge, metacognition, age, etc.

Learning objectives (or domains of learning) are also a crucial condition variable (constraint) of learner control. Gagné (1985) classifies human learning domains into five categories: intellectual skills, verbal information, cognitive strategies, motor skills, and attitudes. Bloom's (1961) three domains (cognitive, affective, and psychomotor) and Merrill's (1983) performance-content matrix (remember, use, and find; fact, concept, procedure, and principle) are good classifications of learning domains. Reigeluth (1989) suggests several types of learning including memorization, understanding, skills application, generic skills, and affective learning.

Instructional/learning systems also seem to be an integral part of learner control. We need to tailor learner control methods to individual instructional/learning systems. Instructional/learning systems include non-individualized system, individualized instructional systems (such as traditional CAI, TICCIT), intelligent learning systems (such as ICAI), and Hypermedia systems.

Instructional Methods

Method variables of learner control in current theory include Merrill's (1984) notion of content control, sequence control, pace control, display (strategy) control, internal processing control such as conscious cognition and metacognition, and intelligent advisor (Merrill, Li, & Jones,1990). In addition, Tennyson's (1985) advisement strategy and Reigeluth's (1979, 1983) notion of macro-level control (such as sequencing, selecting, summarizing, synthesizing), user control, and system control can also be considered as learner control strategies.

Prescriptions of Learner Control

Considering condition, outcome, and method variables of learner control altogether, instructional prescriptions of learner control were contrived in a smorgasbord fashion. Below is a list of learner control prescriptions which, based on the conditions, will optimize the desired instructional outcomes.

A. (CONTENT CONTROL over segments, lessons, units, and courses) Provide learners with more opportunities to make content selection as learners grow older.

e.g.) - junior high school level -- a choice among 2-3 alternatives in addition to required courses
- university level -- almost unlimited options

A1 If one is good at content, one can use options effectively Selection of topic is dependent on the learner's competencies in the topic. (Judd, Bunderson, & Bessent, 1970; Sasscer & Moore, 1984).

A2 Learner control is likely to work well compared to program control when higher order skills rather than factual information are being taught, and when the content is familiar to learners (Hannafin & Peck, 1988). This view supports Reigeluth's (1989) point that, to some extent, user (learner) or system (program) control will be determined by instructional objectives.

B. (SEQUENCE CONTROL) Offer opportunity for student to sequence the objectives within a particular course of instruction in any order IF the student so desires.

B1 DON'T use sequence control WHEN the objectives or contents (segments, lessons, and units of instruction) are sequenced, as in linear delivery systems (lecture, videotape, slide presentations, or movies) which make the reordering of content components difficult.

B2 Use sequence control in self-paced individualized materials (such as workbooks, textbooks, etc) which enable learner to do.

B3 Learners use prior knowledge to determine their instructional sequence (Mager, 1961; Mager & Clark, 1963).

C. (PACE CONTROL) Offer the opportunity to study a given unit or lesson as long as needed IF learners are using individualized instruction or self-paced instruction (Merrill, 1984).

C1 Keep moderate level of control over learning time to make improve performance of learner (Tennyson, Park, & Christensen, 1985).

C2 If learners get coached practice on self-directed study, then they can increase their performance and motivation, and can reduce instruction time (Campbell & Terry, 1963).

D. (DISPLAY or STRATEGY CONTROL) Present a single subject-matter idea .
a general statement (generality) or
a specific example

D1 WHEN students are provided a mechanism for selecting and sequencing those displays which they feel are required to understand a given objective, at least three types of display control are involved.

- selection of the number of displays required for perceived mastery
- control of sequence of different types of displays
- selection of various displays.

D2 Use display selection and sequence control in TICCIT system by means of rule, example, and practice button.

E. (INTERNAL PROCESSING CONTROL) Use a variety of internal processing strategies WHEN the learner interacts with the presentation of the instruction.

Interaction of these internal processes with the stimulus materials will help the learner perform effectively and efficiently.

E1 (CONSCIOUS COGNITION) In order to encode the information presented by a given display, learner should use mental processes.

In order to compensate for inadequate display, learner should appropriately select the cognitive processing activities.

rehearsal, repetition, paraphrasing, imaging, encoding via mnemonic, exemplifying, and covert practice.

Use the introspective interview with learners in order to obtain a record of the processing attempted for each display.

E2 (METACOGNITION) In order to guide their interaction with an instructional system being used, learners should use the "how to study or learn" model.

When learners are taught to use more appropriate methods, they acquire not only subject matter but also some internal theory about "how to learn".

Use the introspective interview technique in order to assess the mata-cognitive models being used by a student.

F. (ADVISOR STRATEGIES in new CDT) Use an Intelligent Advisor in order to determine if a given learner needs a particular type of interaction ("transaction"), which was not originally included in the transaction frame sets of the course.

G. Individual Difference

G1 If high-ability students are put under learner control group and low-ability students are put under external control (Program Control), the performance of both sides will be improved. (Greene, 1976)

G2 Student learning should be individualized because students differ in the way they use instructional options in learner control conditions (Mager & McCann, 1961: Seidel, Wagner, Rosenblaff, Hillelsohn, & Stelzer, 1978)

G3 Instructor should not insist on his/her instructional sequences because learners often prefer different sequences. The most meaningful sequences for the students were different from those used by the instructors. (Mager, 1961; Mager & Clark, 1963)

- Learner sequences: "from a whole to a more complex whole"
- Instructor sequence: "from the part to the whole"

H. Prior Knowledge

H1 If learners have prior knowledge, they tend to select more content option than those without such knowledge (Nelson, 1985).

H2 Learners are likely to enter a learning situation WHEN they have a significant amount of relevant knowledge. (Mager & Clark, 1963)

H3 Use Advance Organizer to improve the effectiveness of learner control (Mayer, 1976).

H4 For learners with a low domain knowledge base, program control is superior to learner control. The difference diminishes for those with a high domain knowledge base. Learner's self-judging ability is contingent on the level of prior domain knowledge (Lee & Lee, 1991).

I. Motivation/Attitude/Feedback

I1 Provide feedback on cumulative performance in order to increase learner control effectiveness. (Schloss, Wisniewski, & Cartwright, 1988).

I2 Provide encouragement, advice, and monitoring strategies in order to improve effectiveness of learner control and student 'on-task' time. (Carrier, Davidson, & Kalweit, 1986)

I3 In order to increase student motivation and attitude of learning, use learner control strategies (Mager, 1961; Newkirk, 1972).

J. Learning Phases:

Use program control instead of learner control for knowledge acquisition. Meanwhile, use learner control instead of program control in the knowledge review phase (Lee & Lee,1991).

K. Self-Assessment/Learning Strategy

K1 Develop learning skills in order to justify initiatives for creating learning environment. (Derry & Murphy, 1986)

K2 Use self-instruction in order to initiate, plan, organize, monitor, and regulate own learning process. (Weiner & Kluwe, 1987)

K3 In order to make good use of learner control, conduct self-assessment. However, young students have difficulty assessing their own performance or their en-route comprehension. (Garhart & Hannafin, 1986)

L. Instructional/Learning Systems

If one understands and manages learner control well, one will feel comfortable with the current conception of intelligent tutoring systems. (Duchastel, 1986).

Conclusion & Implication

We discuss learner control as one of the main issues in instructional management and the importance of effectiveness and efficiency in the

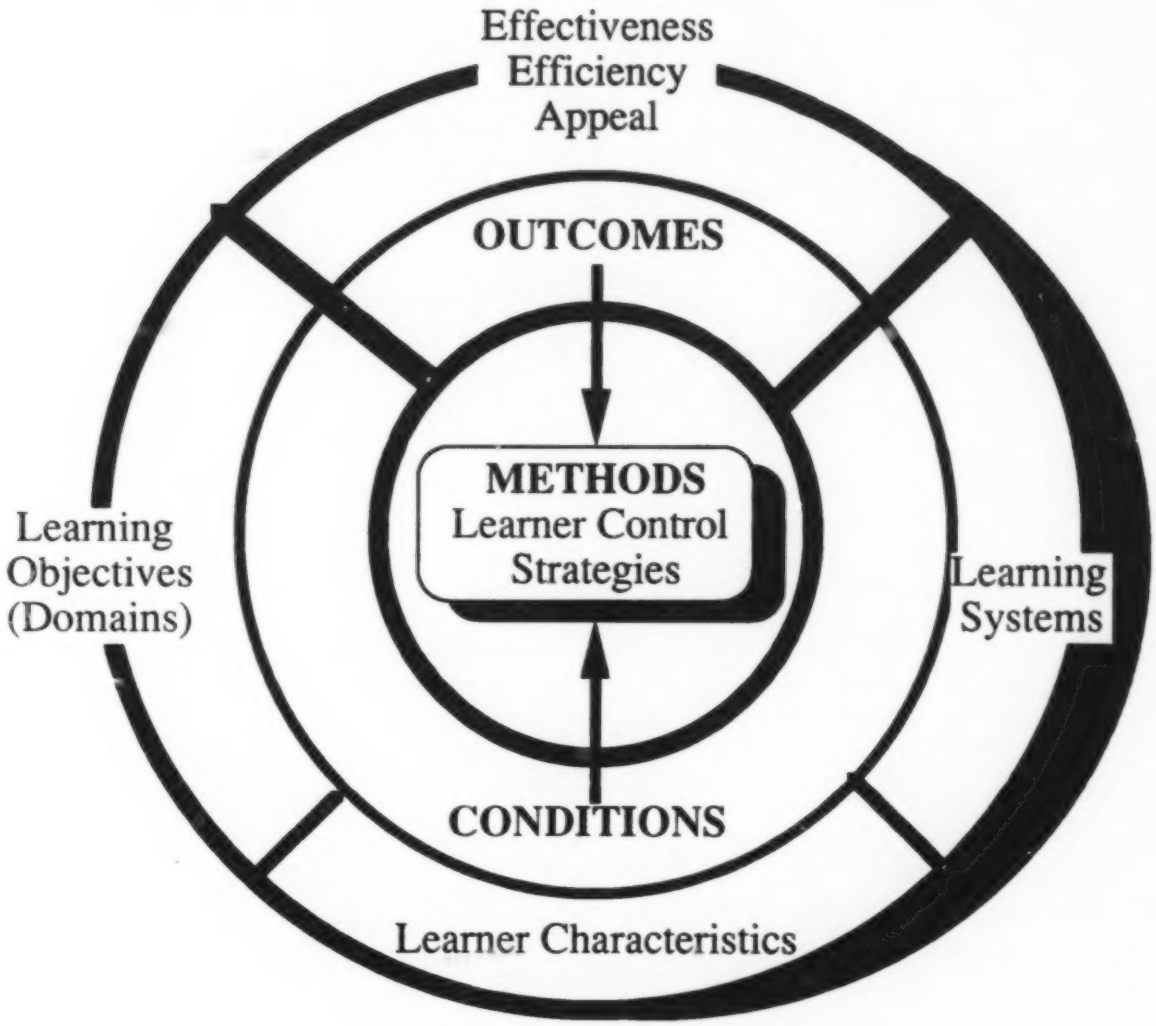
context of instructional/learning systems. Instructional prescriptions of learner control are developed in a smorgasbord fashion.

Teachers and instructional designers may have the chance to consider the functional relationship between learner control and cognitive development of the learner, between the learner control and types of learning (or learning domains), and between learner control and learner's motivation. They can use this prescriptive knowledge base of learner control in order for their students to maximize the effectiveness and efficiency of a given learning situation.

At this point, we should look into our challenges for the future. All instruction involves some learner control. Our challenge is not whether or not learner control should be used, but rather how to maximize the learner's ability to use the learner control available. Every student has some type of internal "how to learn" model which directs his/her learner control. Thus, the most promising area for future exploration is to help learners to develop internal adaptive models which direct their use of appropriate internal processing. We should seek to identify the nature of learner control in every instructional situation and know more about the types of conscious cognitive control which may be appropriate for different outcomes and for different displays. Then, the student who has the most choices available will be best able to maximize the effectiveness and efficiency of a given learning situation.

From a different view, we can provide three suggestions here for tomorrow's learner control research. First, outcomes considered within learner control research should include the development of effective learning strategies, the continuing motivation to learn, and long range achievement. Second, explore ways in which advisement can be offered to assist individuals in the use of learner-controlled features and regulation of their own learning. Third, the relationship between the provision of learner control and student perception of control within instruction should be considered.

Figure1. Variables of Learner Control



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